REGULATED VOLTAGE POWER SUPPLY CONVERSION KIT

124195 124197 124198
124196 124221

LEEDS & NORTHRUP

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1. GENERAL INFORMATION

This conversion kit contains a regulated voltage power supply unit, designed to replace the battery and standard cell used in conventional Speedomax® recorders. The power supply transforms an energy source of normal, a-c line power into d-c for use in the recorder potentiometer circuit. The magnitude of this d-c current is of critical importance, for in passing through the potentiometer circuit it generates the reference voltage with which all unknown voltages are compared. Ambient temperatures between 16 and 75 degrees Centigrade will not affect the precision of the unit's d-c current output. A-c line power, obtained from terminals within the recorder, may vary within the limits of 107-127 V and 48-64 cycles.

2. INSTALLATION

A special mounting bracket plus some additional parts and wires needed to install the power supply unit are included in the kit. As an aid in identifying certain parts of the recorder mechanism, the user is advised to have on hand the appropriate recorder parts catalog; however this is not mandatory.

When the installation is completed, several disconnected wire ends will have been left dangling and will constitute a hazard to the operation of the recorder. These exposed wire ends should be sealed with electrical tape and the free portion of the wire fastened down (using string or tape), such that they will not interfere with the recorder mechanism.

2A. Speedomax G Instruments

(1) Model S Recorder (Single or Multiple-Point)

Remove the dry cell battery. Unsolder the leads to the battery terminal posts and tag their respective polarities since they will be reconnected to the new power supply in the same manner. Remove the battery mounting bracket, battery terminals, and standard cell from the standard cell panel. Clip off the two standard cell leads at the terminals to which they are connected, not at the cell itself. Some recorders have a reference junction compensating coil (eight-terminal resistor) attached to the lower left-hand corner of the standard cell panel; do not disturb the wires belonging to it. Unsolder the two leads attached to the current adjusting rheostat, twist them together, solder the joint and seal the exposed wire with electrical tape.

Remove the worm gear mounted on the shaft which protrudes from the automatic current adjuster mechanism; this gear meshes with the worm on the main drive shaft. Make certain that the automatic current adjuster is in the non-standardizing position, such that the key plunger screw(s) does not touch any of the contact blades on the standardizing switch (mounted on the standard cell panel board). As an optional step, the user may entirely

remove the automatic current adjuster since it is no longer needed. The control knob and connecting linkage for performing manual standardization may also be removed. If parts catalog P-ND46(1) is available, these removable parts are depicted on page 34, (everything illustrated therein), and on page 12, (part nos: 35-37, 44-49, 65 and 66).

Install the power supply in the same location as that of the battery it replaces. Usually it can be mounted as shown in Fig. 1. However, in some instances there are devices mounted on the auxiliary shaft which makes it necessary to mount the power supply as shown in Fig. 1A. It is to be noted that there is little difference in these two mountings. Figs. 1 and 1A illustrate the correct location of the mounting bracket and the two holes which must be drilled and tapped. All dimensions are shown with reference to the two holes previously drilled for the battery support bracket. Fasten the mounting bracket to the recorder frame using two 1/2" #8/32 flat-head screws, two countersunk insulator bushings and the thin composition gasket. Install the power supply in the mounting bracket using the two 1/4" binding-head slotted screws.

The two leads which were formerly attached to the battery terminals must now be soldered to the positive and negative terminals (marked + and −) of the power supply according to their same respective polarities. A short piece of wire (white insulation) is included in the kit for making a ground connection between the GRD terminal on the power supply and the main frame of the recorder. Fasten the ground wire securely by means of some nearby screw and scrape away any paint on the main frame casting so that the ground wire will make good, bare metal contact.

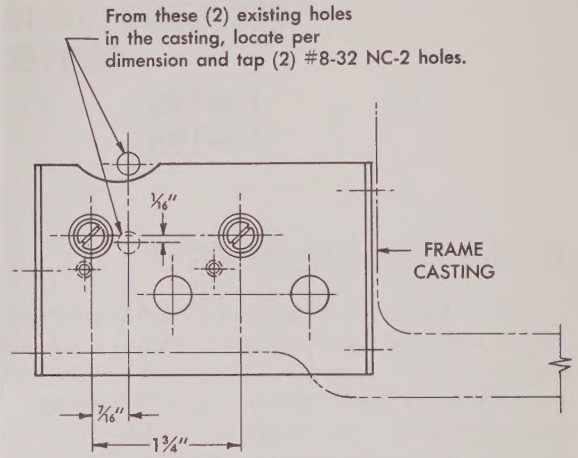

Fig. 1—Normal location of mounting bracket for Speedomax G, Model S Recorder.

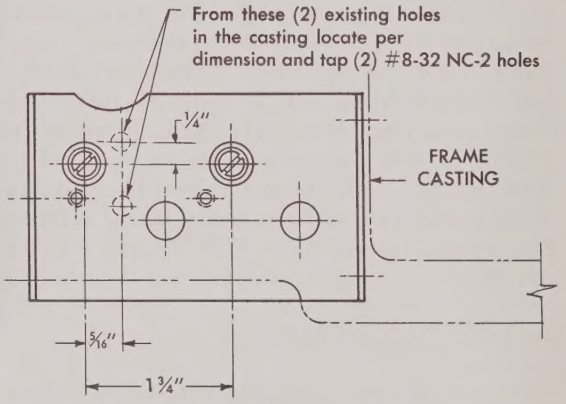

Fig. 1A—Alternate location of mounting bracket for Speedomax G, Model S Recorder.

The two thirty-inch leads, one black and one white, must be twisted together and one pair of the wire ends soldered to the a-c terminals of the power supply. Run the twisted pair of leads directly up from the power supply to the balancing motor terminal board, cut off the excess wire, and fasten the ends to the terminals marked B and W. Support the twisted pair at one or two points along the frame (using tape or pieces of string)

so it will not hinder the operation of the recorder. Lastly, re-install the protective guard for the a-c terminals of the power supply unit.

See Section 3 for final adjustments and calibration.

(2) Model R Recorder

Remove the dry cell battery. Unsolder the leads to the battery terminal posts and tag their respective polarities since they will be reconnected to the new power supply in the same manner. Remove the battery mounting bracket, battery terminals, and standard cell from the standard cell panel. Clip off the two standard cell leads at the terminals to which they are connected, not at the cell itself. Some recorders have a reference junction compensating coil (eight-terminal resistor) attached to the lower left-hand corner of the standard cell panel; do not disturb the wires belonging to it.

There are two types of current adjuster assemblies in use on Model R recorders: automatic (having its own a-c drive motor), and semi-automatic (no drive motor). If a parts catalog is available, illustrations of these two assemblies can be seen on pages 19 and 20. On recorders having an automatic current adjuster, the two leads from the small a-c drive motor must be disconnected at the motor terminal board (in the upper left-hand corner of the main frame casting). On either type of recorder, the two leads to the current adjusting rheostat must be clipped off, twisted together, the joint soldered and the exposed wire sealed with electrical tape.

As an optional step, the user may entirely remove the current adjusting assembly since it is no longer needed. The pushbutton on the front of the main frame, used for manual standardization, and its connecting linkage may also be removed. Before doing so, note the following circuitry changes:

—Automatic current adjusters have a small, three-terminal switch mounted on the bottom, which is actuated by a pushbutton projecting from the side of the switch. Remove the lead which connects the switch to the Y-resistor and standard cell and cover the exposed end with insulating tape. Disconnect the two remaining leads, twist the ends together, solder and tape.

—Semi-automatic current adjusters have a three-terminal switch with spring blade contacts mounted on the side of their support casting. Clip off the leads to the terminals of the center blade and the shortest of the two outer blades, twist them together, solder the junction, and seal the exposed wire with electrical tape. The remaining lead must be clipped off and the exposed wire-end sealed with tape.

The current adjusting mechanism (either type) is now electrically isolated and can be removed as a unit from the recorder main frame. The automatic current adjuster is fastened to the main frame with three screws and the semi-automatic current adjuster with two screws.

Install the power supply in the same location as that of the battery it replaces. Fig. 2 illustrates the correct location of the mounting bracket and the two holes which must be drilled and tapped. Fasten the mounting bracket to the panel board using two 3/8" #8/32 flat-head screws and the two countersunk insulator bushings. Install the power supply in the mounting bracket using the two 1/4" binding-head slotted screws.

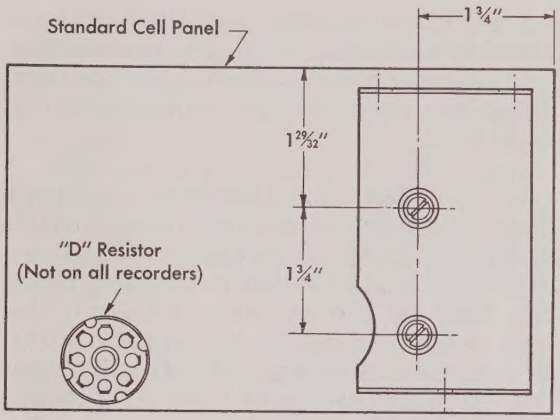

Fig. 2—Location of mounting bracket for Speedomax G, Model R Recorder.

The two leads which were formerly attached to the battery terminals must now be soldered to the positive and negative terminals (marked + and −) of the power supply according to their same respective polarities. A short piece of wire (white insulation) is included in the kit for making a ground connection between the GRD terminal on the power supply and the main frame of the recorder. Fasten the ground wire securely by means of a screw, such as one of those which formerly supported the current adjuster. Scrape away any paint on the main frame casting so that the ground wire will make good, bare metal contact.

The two thirty-inch leads, one black and one white, must be twisted together and one pair of the wire ends soldered to the a-c terminals of the power supply. Run the twisted pair of leads directly up from the power supply about two or three inches and then horizontally along the back face of the main frame to the motor terminal board (located in the upper left-hand corner). Fasten the ends to the terminals marked B and W on the motor terminal board after cutting off the excess wire. Support the twisted pair at several points along the frame (using tape or pieces of string) so it will not hinder the operation of the recorder. Lastly, re-install the protective guard for the a-c terminals of the power supply unit.

See Section 3 for final adjustments and calibration.

(3) Model X-Y Recorder

Two separate sources of power are used in this type of recorder: the X-function battery is attached to the main frame, the Y-function battery to the back wall of the recorder case.

X-function: Remove the dry cell battery. Unsolder the leads to the battery terminal posts and tag their respective polarities since they will be reconnected to the new power supply in the same manner. Remove the battery mounting bracket, battery terminals, and standard cell from the standard cell panel. Clip off the two standard cell leads at the terminals to which they are connected, not at the cell itself. Some recorders have a reference junction compensating coil (eight-terminal resistor) attached to the lower left-hand corner of the standard cell panel; do not disturb the wires belonging to it.

Y-function: Remove the dry cell battery. Unsolder the leads to the battery terminal posts and tag their respective polarities. Remove the bakelite mounting board from the back wall.

Two current adjusting rheostats, one for each battery, are mounted on the instrument panel above the indicator scale. Both of these rheostats must be shorted out by soldering a short piece of wire between the terminals on the back of

each rheostat, or the rheostats may be removed and the wires connected together.

Removal of the standard cell has rendered the standardizing switch (or pushbutton) on the instrument panel inoperative. However, if an attempt is made to standardize the circuit by actuating that switch, as was formerly the practice, the emf input to the recorder will be open circuited. Hence it is suggested that the user fasten a small paper tag near the switch with a few words of warning, such as "Do not use switch". It should be noted that the recorder can in no way be damaged by moving this switch; it is merely that the emf input to the recorder will be disrupted.

Install the power supplies in the same locations as those of the batteries they replace. Figs. 1 and 3 illustrate the correct locations of the mounting brackets and the two holes which must be drilled and tapped for the brackets for the X-function power supply and the Y-function power supply respectively. Fasten the X-function bracket using two 1/2" #8/32 flat-head screws, two countersunk insulator bushings, and the thin composition gasket. Fasten the Y-function bracket using one 1/2" #8/32 and one 3/8" #8/32 flat-head screw, two countersunk insulator bushings, and the thin composition gasket. Install the power supply in its mounting bracket using two 1/4" binding-head slotted screws.

X-function: The two leads which were formerly attached to the battery terminals must now be soldered to the positive and negative terminals (marked + and −) of the power supply according to their same respective polarities. A short piece of wire (white insulation) is included in the kit for making a ground connection between the GRD terminal on the power supply and the main frame of the recorder. Fasten the ground wire securely by means of some nearby screw and scrape away any paint on the main frame casting so that the ground wire will make good, bare metal contact.

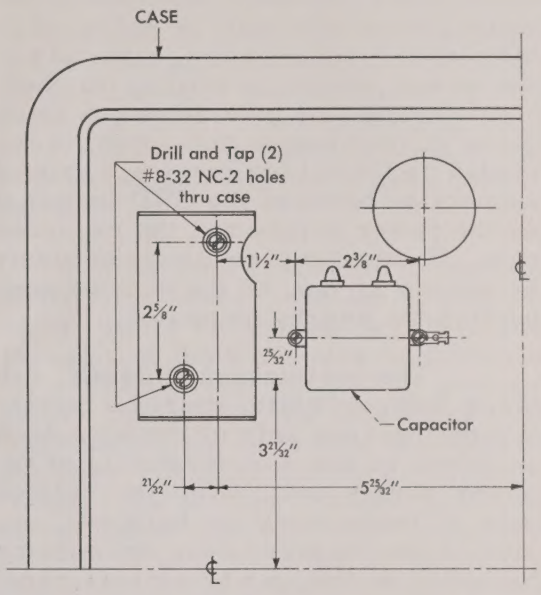

Fig. 3—Location of mounting bracket for Y function in Speedomax G, X-Y Recorder.

The two thirty-inch leads, one black and one white, must be twisted together and one pair of the wire ends soldered to the a-c terminals of the power supply. Run the twisted pair of leads directly up from the power supply to the balancing motor terminal board, cut off the excess wire, and fasten the ends to the terminals marked B and W. Support the twisted pair at one or two points along the frame, (using tape of pieces of string) so that it will not hinder the operation of the recorder. Lastly, re-install the protective guard for the a-c terminals of the power supply unit.

Y-function: The two leads which were formerly attached to the battery terminals must be soldered to the positive and negative terminals of the power supply according to their same respective polarities. A short piece of lead (white insulation) is included in the kit for making a ground connection between the GRD terminal on the power supply and the recorder case. Fasten the ground wire securely by means of one of the screws supporting the nearby capacitor.

The two thirty-inch leads, one black and one white, must be twisted together and one pair of the wire ends soldered to the a-c terminals of the power supply unit. Run the twisted pair of leads along the back wall and side of the recorder case out onto the backside of the instrument panel mounted on the main frame. Cut off any excess wire and fasten these leads to the two center terminals (one above the other) of the LINE switch. Support the twisted pair at several points along the back and side walls of the case (using tape or pieces of string) so it will not hinder the operation of the recorder. Lastly, re-install the protective guard for the a-c terminals of the power supply unit.

See Section 3 for final adjustments and calibration.

(4) Model X-X Recorder

The following instructions presume that the user is installing power supply units for both the X_1 function and the X_2 function. If, in fact, the user is installing only one unit, that part of the instructions dealing with the second power supply installation must be disregarded.

Remove the two dry cell batteries from the back wall of the recorder. Unsolder the leads to the battery terminal posts and tag them according to their respective polarities since they will be reconnected to the new power supplies in the same manner. Remove the two bakelite mounting boards including the battery support brackets and terminal posts.

Remove the standard cell from its panel mounting, clipping the two standard cell leads at the terminals to which they are connected, not at the cell itself. On some recorders the standard cell is somewhat obscured by an extension of the main frame, however, the two screws holding the standard cell panel in place can easily be turned from the opposite side of the frame on which the panel is mounted.

Two current adjusting rheostats, one for each battery, are mounted on the instrument panel above the indicator scale. Both of these rheostats must be shorted out by soldering a short piece of wire between the terminals on the back of each rheostat, or the rheostats may be removed and the wires connected together.

Removal of the standard cell has rendered the current standardizing switch (or pushbutton) on the instrument panel inoperative. However, if an attempt is made to standardize the circuit by actuating that switch, as was formerly the practice, the emf input to the recorder will be open circuited. Hence it is suggested that the user fasten a small paper tag near the switch with a few words of warning, such as "Do not use switch". It should be noted that the recorder can in no way be damaged by actuating this switch; it is merely that the emf input to the recorder will be disrupted.

Install the power supplies in the same locations as those of the

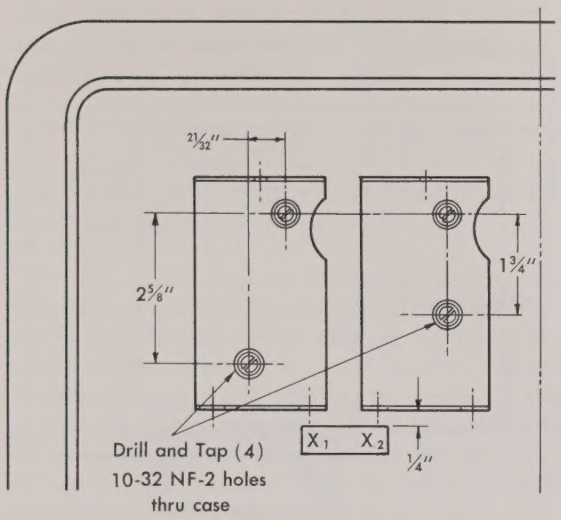

Fig. 4—Location of mounting brackets for Speedomax G, X-X Recorder.

batteries they replace. Fig. 4 illustrates the correct locations of the mounting brackets and the two holes which must be drilled and tapped for each bracket. Fasten each bracket using two 3/8" #10/32 flat-head screws, two countersunk insulator bushings, and a thin composition gasket (between the bracket and the case wall). Install the power supply in its mounting bracket using two 1/4" binding-head slotted screws. Fasten the gummed label bearing the symbols X_1-X_2 to the back wall just beneath the two power supplies.

The two leads which were formerly attached to the X_1 battery (nearest the side wall) must now be soldered to the positive and negative terminals (marked + and −) of the X_1 power supply according to their same respective polarities. Likewise, connect the two leads which were formerly attached to the X_2 battery to the + and − terminals of the X_2 power supply. Splice short lengths of wire on to these leads if they will not reach their respective terminals. A short piece of wire (white insulation) is included in each kit for making a ground connection between the GRD terminal of each power supply and the recorder case. Fasten each ground wire securely by means of one of the screws supporting the nearby capacitors.

For the X_1-function, the two thirty-inch leads, one black and one white, must be twisted together and one pair of the wire ends soldered to the a-c terminals of the X_1 power supply unit. Run the twisted pair of leads along the back wall and side of the case out on to the recorder main frame. Cut off any excess wire and fasten these leads to the terminals marked B and W on the X_1 balancing motor terminal board. This is the motor terminal board mounted nearest the upper hinge of the main frame assembly. Repeat this procedure identically for the X_2-function, including the final wiring connections which must also be made at the B and W terminals of the X_1 balancing motor terminal board. Support these wires at several points along the back and sides of the recorder case (using tape or pieces of string) so they will not hinder the operation of the recorder. Lastly, re-install the protective guards for the a-c terminals of the power supply units.

See Section 3 for final adjustments and calibration.

(5) Model D Indicator

Remove the dry cell battery. Unsolder the leads to the battery terminal posts and tag their respective polarities since they will be reconnected to the new power supply in the same manner. Remove the battery support bracket and the bakelite mounting board—if one exists.

Remove the standard cell from its panel mounting, clipping the two standard cell leads at the terminals to which they are connected, not at the cell itself. Disconnect the two leads attached to the current adjusting rheostat, twist them together, solder the joint and seal the exposed wire with electrical tape. The current adjusting rheostat, rheostat contacts and their support bracket, and the connecting linkage from the standardizer control button on the front door panel, may be removed if desired. All of these parts are depicted on page 10 of Parts Catalog P-ND46(3).

Install the power supply in the same location as that of the battery it replaces. For the more recently manufactured instruments, this mounting location is illustrated in Fig. 5. Two holes must be drilled in the frame casting and corresponding holes in the mounting bracket must be tapped. The power supply must be fastened to its mounting bracket and then held in place on the frame casting while the two screws for the mounting bracket are inserted. Older models of this indicator have no built-in "shelf" as part of their frame casting, hence the bakelite board on which the battery was mounted must be used for the new installation as well.

The two leads which were formerly attached to the battery terminals must be soldered to the terminals marked + and – of the power supply according to their same respective polarities. A short piece of wire (white insulation) is included in the kit for making a ground connection between the GRD terminal of the power supply and the main frame of the recorder. The two forty-eight inch leads, one black and one white, must be twisted together and one pair of the wire ends soldered to the a-c terminals of the power supply unit.

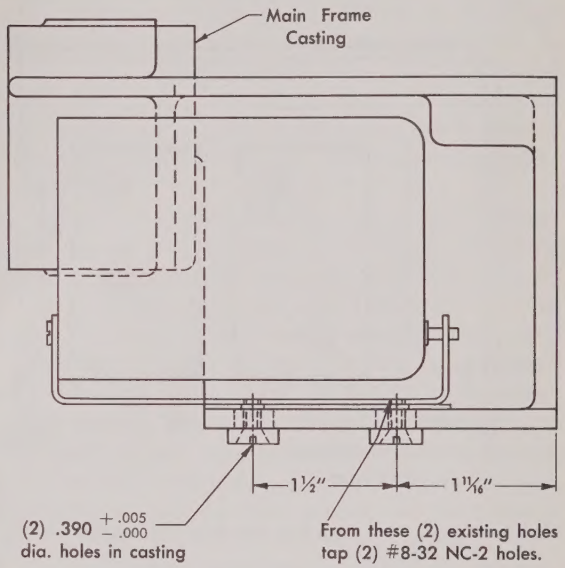

Fig. 5—Location of mounting bracket for Speedomax G Indicator with drum type scale.

Run the twisted pair of leads to the balancing motor terminal board, cut off the excess wire, and fasten the ends to the terminals marked B and W.

See Section 3 for final adjustments and calibration.

(6) Speedomax G, Rack Mounted Indicator with Round Type Scale

Remove the dry cell battery. Disconnect the leads to the battery terminal posts and tag their respective polarities since they will be reconnected to the new power supply in the same manner. Remove the battery support bracket, battery terminals, and standard cell, clipping the two standard cell leads at the terminals to which they are connected, not at the cell itself. Disconnect the two leads attached to the current adjusting rheostat, twist them together, solder the joint and seal the exposed wire with electrical tape. If desired,

the complete current adjusting assembly may be removed. This will require two additional wiring changes:

—Disconnect, at the motor terminal board, the two leads from the small a-c motor which drives the current adjusting assembly.

—There is a small, three-terminal switch mounted on the underside of the current adjusting assembly; it is actuated by a small push-button projecting from the side of the switch. Clip off the lead attached to that terminal of the switch which runs to the Y-resistor and standard cell, and seal the exposed wire end with tape. Clip off the two remaining leads, twist them together, solder the junction, and seal the exposed wire with electrical tape. The assembly is now electrically isolated and can be removed as a unit from the recorder main frame.

Install the power supply mounting bracket on the standard cell panel board, locating it as shown in Fig. 6. The two leads which were formerly attached to the battery terminals must be soldered to the terminals marked + and – of the power supply according to their same respective polarities.

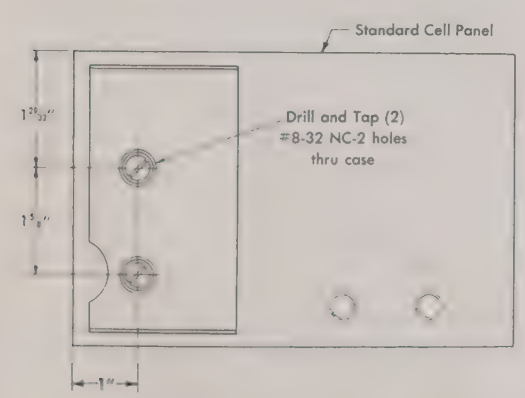

Fig. 6—Location of mounting bracket for Speedomax G Indicator with round type scale.

A short piece of wire (white insulation) is included in the kit for making a ground connection between the GRD terminal of the power supply and the main frame of the recorder. The two forty-eight inch leads, one black and one white, must be twisted together and one pair of the wire ends soldered to the a-c terminals of the power supply. Run the twisted pair to the balancing motor terminal board, cut off the excess wire, and fasten the ends to the terminals marked B and W.

See Section 3 for final adjustments and calibration.

2B. Speedomax H Instruments

Remove the dry cell battery and its mounting bracket. Disconnect at all points and remove entirely, the two large wiring cables which terminate in the form of plugs at the amplifier. Make a note of the manner in which the cables are threaded through the main frame while they are being removed, so that the replacement cables can be installed in the same manner. The three wiring cable leads to the back of the measuring slidewire must be unsoldered (slidewire need not be removed), as well as the two leads to the damping potentiometer on those recorders having a one-second balance time.

The standard cell is located in the lower left-hand corner of the recorder case, directly behind the circuit panel. Access to the standard cell is accomplished by removing the circuit panel (held by two screws), and then removing the two large hex studs and two small bolts supporting the cover for the standard cell case. Remove the standard cell from its case as well as the two leads by which it is connected to the circuit panel. Re-install the empty case and the circuit panel in their original locations.

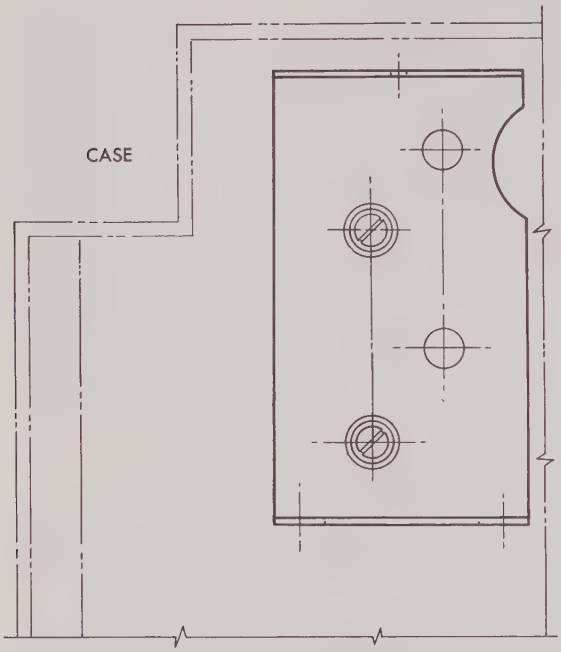

Fig. 7—Location of mounting bracket for Speedomax H Recorder.

The complete timer and current standardizer assembly may be removed from the main frame since they will no longer be needed. Remove the timer assembly first, by taking out its three mounting screws and disconnecting the two timer motor leads from the terminals marked B and W on the motor terminal board. Following this, unsolder the two leads to the current adjusting rheostat, twist them together, solder the junction and seal the exposed wire with electrical tape. Finally, take out the three mounting screws for the standardizer assembly and lift the unit directly up from the main frame casting. In order to provide clearance for standardizer removal on the Model S recorder, it may be necessary to loosen the pen drive cord. This can be accomplished by removing the take-up pulley bracket for the pen drive cord a slight amount.

Install the power supply in the same location as that of the battery it replaces. Fig. 7 illustrates the correct location of the mounting bracket; the same two holes in the bottom of the recorder case may be used. Fasten the bracket using two 5/16" flat-head screws, two countersunk insulator bushings, and the thin composition gasket. Install the power supply in its mounting bracket using two 1/4" binding-head slotted screws.

Refer to Fig. 8 or Fig. 9 for the appropriate illustration of the connections of the new wiring cables supplied with the kit. Note that the special resistor supplied with the kit must be soldered to the + and – terminals of the power supply unit. A small piece of aluminum having two drilled holes is to be used as a cable clamp between the power supply unit and the bottom of the recorder case (see Fig. 10). Also, a protective guard is supplied for use over the a-c terminals of the power supply.

Note the following information if applicable to the particular kit purchased by the user.

—Kit #124197, for recorders having a five-second balance time and an amplifier fail-safe attachment which operates in the upscale direction. The cylindrical aluminum socket adapter is to be inserted between the amplifier output plug (at the upper end of the amplifier) and the motor cable. The black plastic socket adapter is to be inserted between the converter and the cable connected to the top of it.

—Kit #124221, for recorders having a one-second balance time and an amplifier fail-safe attachment which operates in the upscale direction. The cylindrical aluminum socket adapter is to be inserted between the amplifier output plug (at the upper end

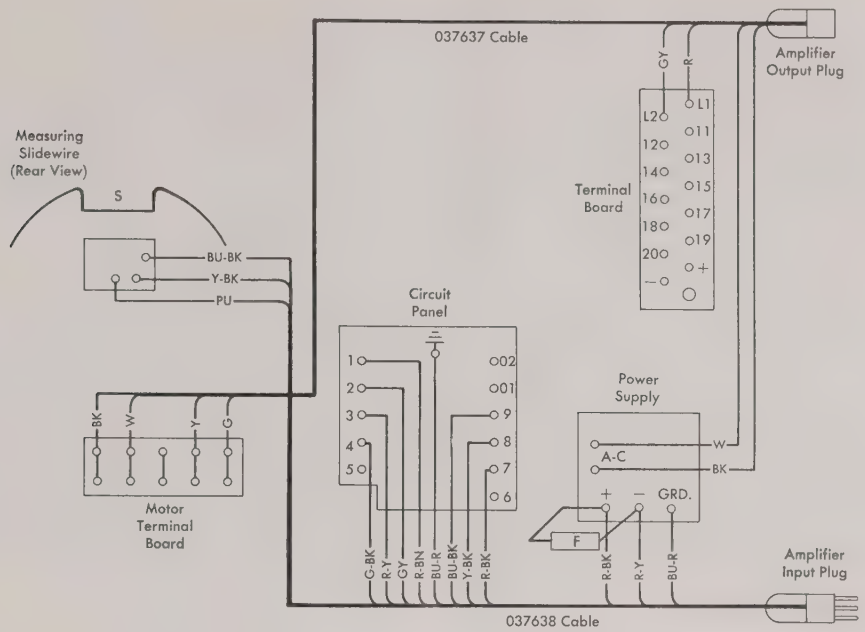

Fig. 8—Wiring cable connections in Speedomax H Recorder with normal 5-second balance time.

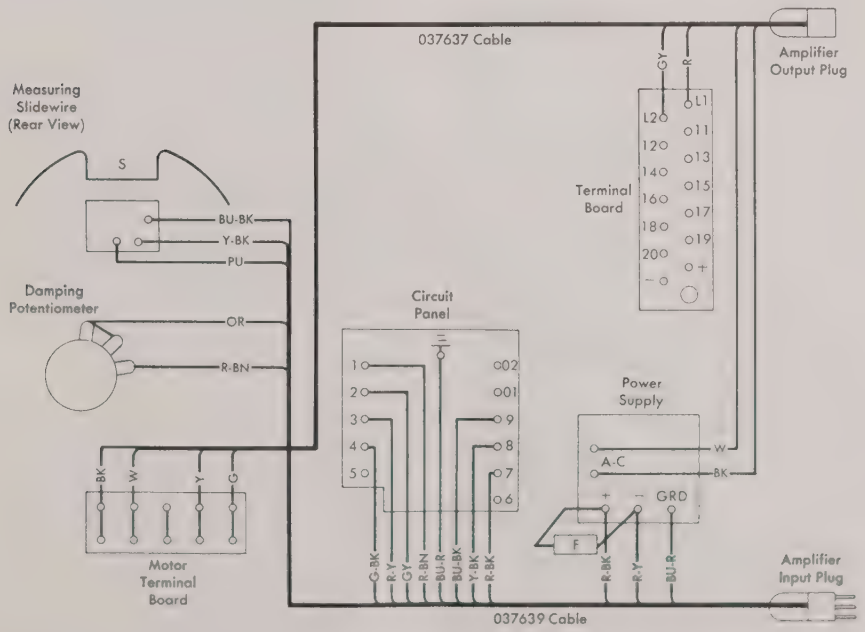

Fig. 9—Wiring cable connections in Speedomax H Recorder with special 1-second balance time.

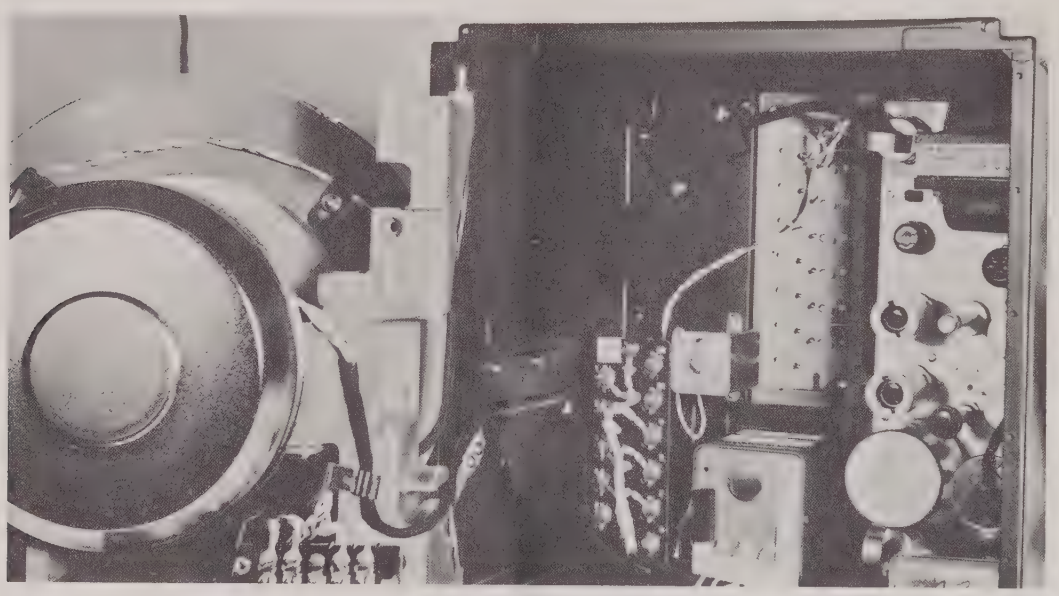

Fig. 10—Power Supply Unit installed in Speedomax H Recorder.

of the amplifier) and the motor cable. The black plastic socket adapter is to be inserted between the converter and the cable attached to the top of it.

—On recorders having an amplifier fail-safe attachment which operates in the downscale direction, the adapter at the amplifier output plug and the adapter at the top of the converter must be removed before inserting the motor cable and converter cable.

When converting a Speedomax H EMF Recorder (calibrated for use with pH indicators) with battery-standard cell arrangement to one with a regulated power supply, make certain that circuit panel cable terminal 7 is connected to circuit panel terminal 6. This connection replaces the connection to circuit panel terminal 7 normally made in TC and EMF recorders.

See Section 3 for final adjustments and calibration.

2C. Micromax® Recorders (Strip and Round Chart)

Remove the dry cell battery. Disconnect the leads to the battery terminals and tag their respective polarities since they will be reconnected to the new power supply in the same manner. Remove the battery support bracket, battery terminals, and standard cell, clipping the two standard cell leads at the terminals to which they are connected, not at the cell itself.

Remove the worm gear mounted on the shaft which protrudes from the automatic current adjuster mechanism; this gear meshes with the worm on the main drive shaft. Make certain that the automatic current adjuster is in the non-standardizing position, such that the key plunger screw(s) does not touch any of the contact blades on the standardizing switch (mounted on the

standard cell panel board). As an optional step, the user may entirely remove the automatic current adjuster since it is no longer needed. The control knob and connecting linkage for performing manual standardization may also be removed.

Figs. 11 and 12 illustrate the mounting bracket locations for the two types of recorders. Drill and tap the case wall as shown, install the mounting bracket together with its insulating gasket and bushings, and then install the power supply. The two leads which were formerly attached to the battery terminals must be soldered to the terminals marked + and – of the power supply according to their same respective polarities. A short piece of wire (white insulation) is included in the kit for making a ground connection between the GRD terminal of the power supply and the recorder case.

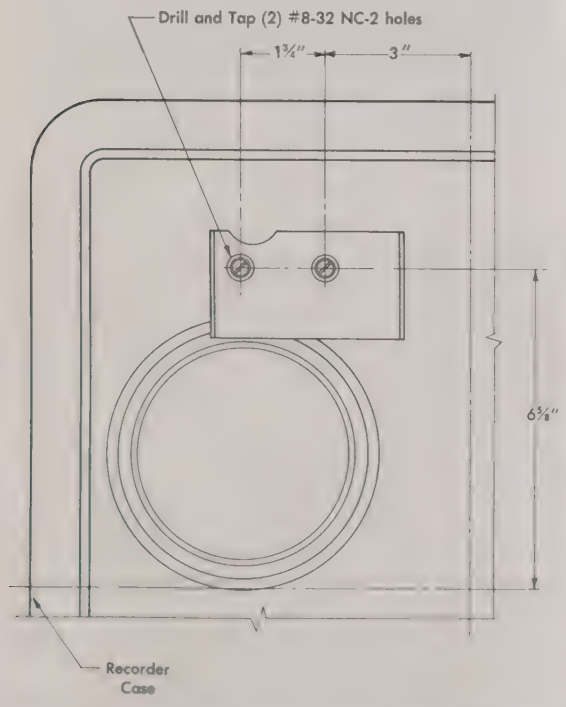

Fig. 11—Location of mounting bracket for Micromax, Model S Recorder.

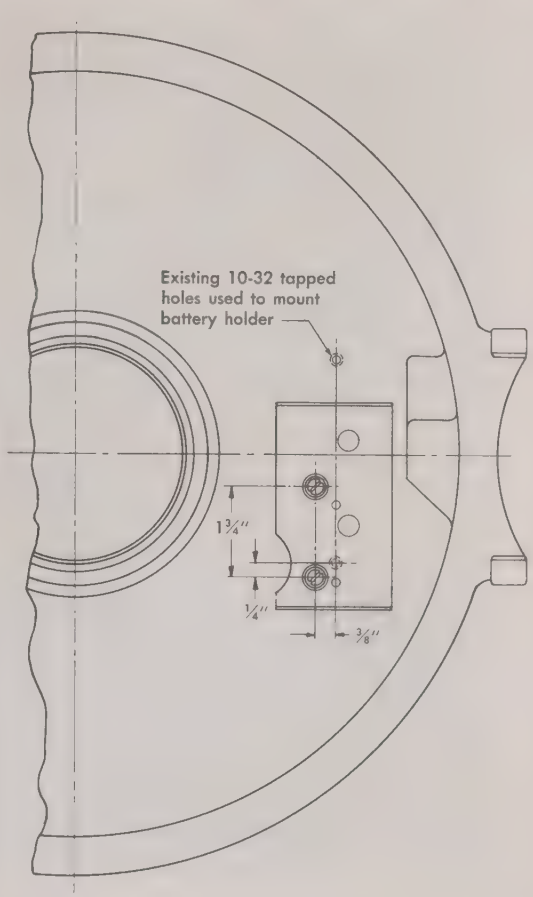

Fig. 12—Location of mounting bracket for Micromax, Model R Recorder.

The two forty-eight inch leads, one black and one white, must be twisted together and one pair of the wire ends soldered to the a-c terminals of power supply. Run the twisted pair to the terminal block of the chart drive motor, cut off the excess wire, and fasten the ends to the terminals marked B and W.

3. FINAL ADJUSTMENTS AND CALIBRATION

3A. General

There is a particular setting for

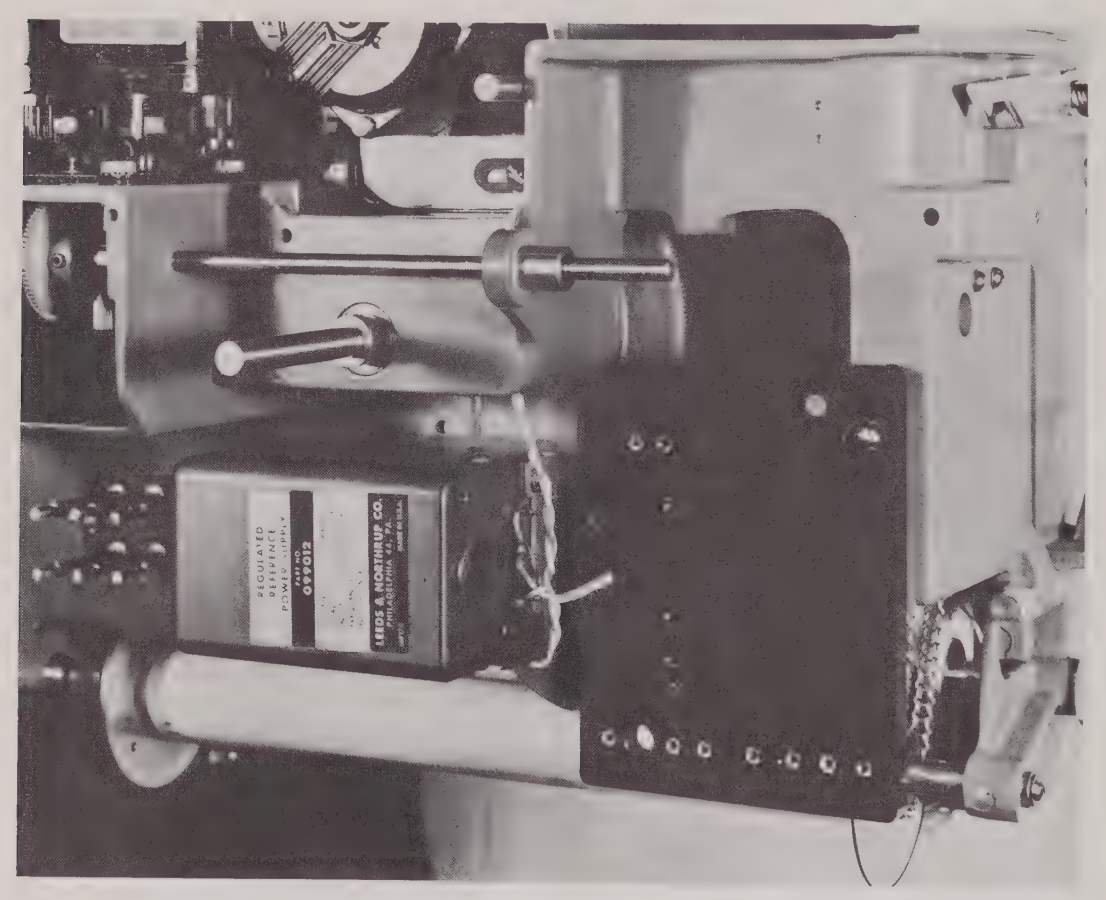

Fig. 13—Power supply Unit installed in Speedomax G Recorder per Fig. 1.

each power supply unit such that it will generate d-c current of the required accuracy. An adjustment screw is provided on the unit for the purpose of making that setting; the screw itself being connected to the movable arm of a small rheostat. The optimum setting of the adjustment screw is a function of the resistance of the recorder potentiometer circuit, which varies slightly in all recorders. As a consequence, any future changes in the electrical circuitry of the recorder, such as the installation of new parts or repair work, will necessitate re-executing this adjustment procedure.

A good quality reference potentiometer is needed for making this check; L&N® No. 8662 or 8690 Portable Millivolt Potentiometers are ideally suited to such applications. The millivoltage output of the potentiometer must be at least as great as the millivoltage range of the recorder. This range, if not indicated directly on the scale, can be determined in either of two ways: (a) On newer model recorders it is stamped directly on the nameplate mounted on an inner wall of the case, or (b) Conversion tables must be used on older model recorders which measure some quantity other than voltage. For example,

if the recorder measures temperatures detected by a thermocouple, and the maximum temperature on the recorder scale is 1000 F, then the tables for that particular thermocouple must be consulted and the millivoltage corresponding to 1000 F read there.

The calibration procedure is essentially unaltered by the use of a power supply unit in place of the battery-standard cell arrangement. Just as before, a known, accurate emf source is substituted for the usual primary element (e.g., a thermocouple). If the recorder is properly calibrated the scale pointer will travel directly to the position on the scale which corresponds to the magnitude of the reference potentiometer input. If there is a small error between potentiometer input and scale reading, the adjustment screw on the power supply may be turned until the two readings correspond. Allow at least a half-hour for the power supply unit to warm up before proceeding with the electrical adjustments and calibration.

Calibration is, of course, a final adjustment and presupposes the correct mechanical settings of the scale and slidewire. These conditions of proper alignment are given in the direction book originally supplied with the instrument. If the recorder is furnished with an automatic reference junction compensator, it will be necessary to measure the temperature of the compensator coil and to use temperature conversion tables to determine the "effective" millivoltage of the test input signal.

If the reference potentiometer and scale pointer readings fail to correspond, despite any setting of the power supply adjustment screw, the power supply should be checked directly with a voltmeter. To accomplish this, unsolder the leads to the terminals marked + and – on the power supply unit, and connect a resistance across these same two terminals of value somewhere between 101 and 109 ohms. With the power supply energized, a voltmeter connected across the + and – terminals should read between 1.01 and 1.09 V. The position of the adjustment screw on the power supply may have to be changed in order to get a voltage output within the range specified. Obviously if the power supply is operating properly, the fault lies elsewhere in the recorder and the user should consult the direction book that was originally issued with the instrument for the complete check-out procedure.

3B. Interference

Some Speedomax instruments are susceptible to interference problems; these involve the pick-up of unwanted a-c signals in the low level input and measuring circuits. Among the possible adverse effects of interference are: sluggish operation, excessive dead band, and inaccurate calibration. The problem is obviated, in the Speedomax G, by making the wiring changes indicated below. Most of these changes are made at the pins of the amplifier male input plug shown in Fig. 14. This is the six terminal plug which enters the amplifier near the left-hand wall of the recorder case

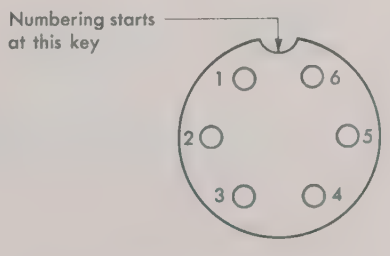

Fig. 14—Amplifier input plug—viewed from solder connection side.

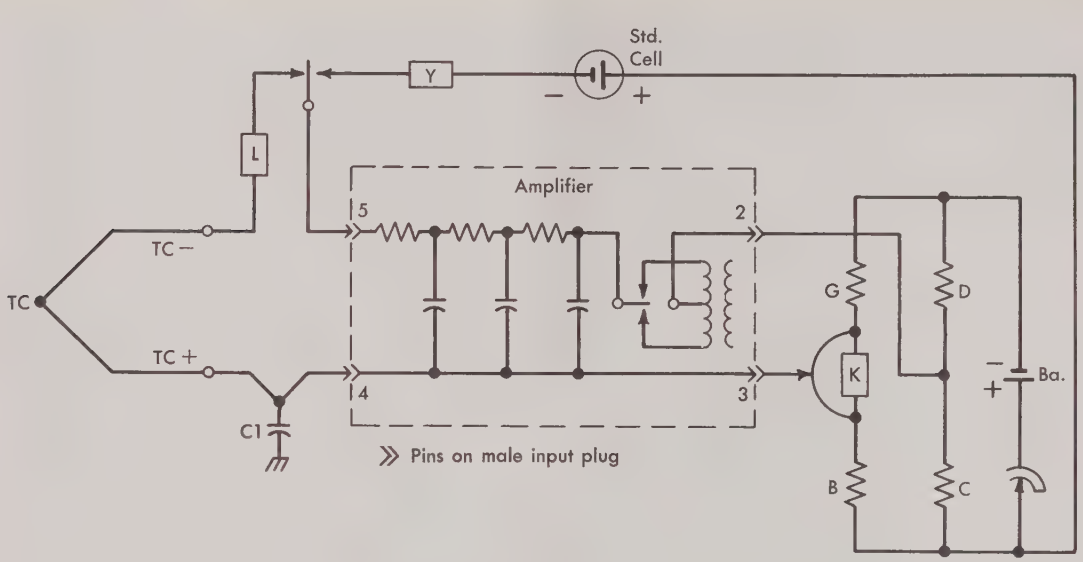

Fig. 15—Typical battery and standard cell measuring circuit.

(looking into the recorder). To expose the soldered terminal connections, bend back the small lips of the protective cover and slide the cover back up the cable.

Fig. 15 shows the connections, which are to be changed, as they are when the battery and standard cell are used. Fig. 15A shows these connections after being changed for use with the power supply unit.

Refer to Figs. 15 and 15A and make the following wiring changes:

—Disconnect the leads to the high side of capacitor C1, twist these two leads together and solder them.

—At the amplifier male input plug, reverse the leads to pins 2 and 3 and reverse the leads to pins 4 and 5.

—Add a new lead from the high side of capacitor C1 to pin 4 of the amplifier male input plug.

—Reverse the Y and G leads at the balancing motor terminal block.

—Orient the a-c power leads to the power supply unit for minimum noise voltage at the control winding of the balancing motor.

The above procedure does not apply to the Speedomax H conversion since the replacement cable for this type recorder has been wired in this special manner at the factory.

A second form of unwanted interference can develop sometimes in the a-c power leads to the power supply unit. It can be minimized by reversing the connections of the a-c leads; make the reversal at the motor terminal board to avoid any soldering. These leads, of course, must be closely twisted together. Since there is no way of predicting which arrangement of the power leads is correct, both must be tried and the connection giving the best response and sensitivity should be selected.

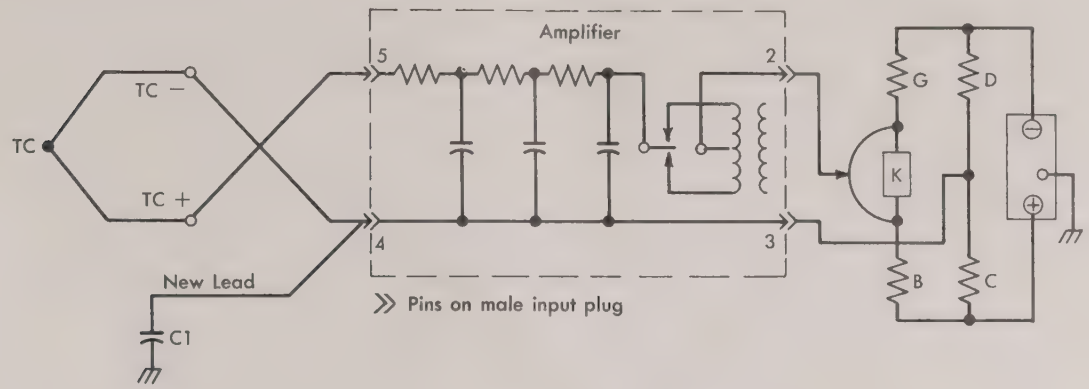

Fig. 15A—Circuit shown in Fig. 15 converted to regulated voltage power supply.

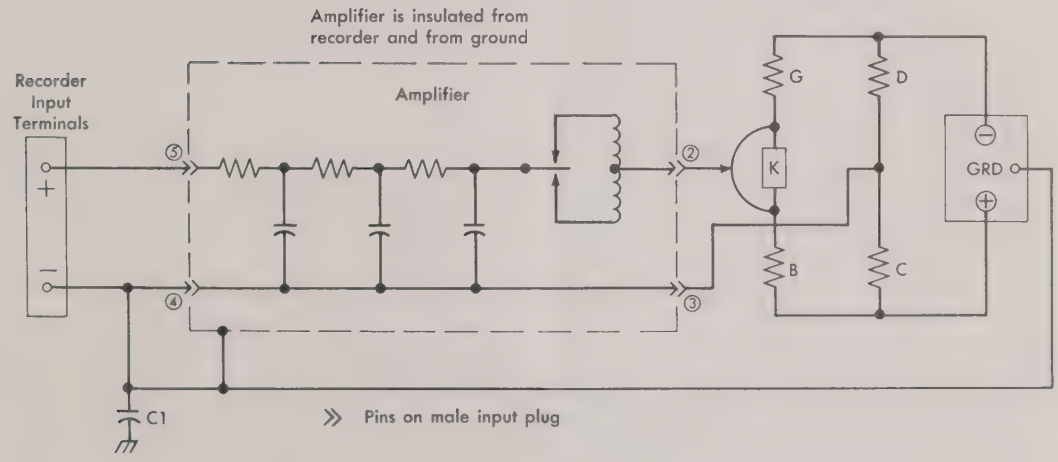

Fig. 15B—Ground connections when primary element is subjected to a-c potentials with respect to ground.

In some installations the primary element, such as a thermocouple immersed in an induction furnace, may be subjected to a-c potentials with respect to ground. These potentials may be of such magnitude as to seriously affect the sensitivity of the amplifier. In such instances, it may be found advisable to make the connections to ground, for the amplifier and regulated power supply unit, as shown in Fig. 15B. Here the amplifier and regulated power supply unit are insulated from the recorder case. In addition the chassis of the amplifier and GRD terminal of the power supply unit are connected to the high side of capacitor C1, Fig. 15B, and to the negative input terminal of the amplifier.

3C. Rayotube® Recorders

Two additional steps must be taken before calibrating Rayotube recorders: A small rheostat (designated the Y coil) is mounted on the back end of the Rayotube compensator assembly—its adjustable arm is geared to the shaft of that same dial. Cut the two leads to this rheostat to remove it from the circuit. Secondly, reverse the polarity of the amplifier input filter as instructed in Section 3B above. Also, reverse the Y and G leads at the motor terminal block.

The full-scale position of the scale pointer will be used as the check point for recorder calibration. Note the millivoltage value inscribed on the nameplate of the Rayotube which will be used with the recorder. Set the compensator dial of the recorder at this value; compensator setting determines the range of the instrument. Connect a good quality portable potentiometer to the recorder input terminals (Rayotube leads disconnected). Set the potentiometer also to the millivoltage that is inscribed on the Rayotube; when the recorder is turned on this input should drive the scale pointer upwards to the highest temperature reading of the scale. This temperature reading corresponds to the temperature value inscribed on the Rayotube nameplate. Make certain that a null balance is actually attained at this highest point on the scale, not that the pointer is merely halted by the mechanical stop. If the pointer does not rest opposite this highest temperature reading, turn the adjustment screw on the power supply until it does so. In so far as the power supply unit is concerned, the recorder is now calibrated and the Rayotube leads can be reconnected to the input terminals.

Almost every Rayotube installation differs somewhat from true black body conditions—the compensator is needed to correct this difference. Remove the Rayotube from its mounting and measure the temperature of the hot body with an optical pyrometer or thermocouple. Replace the Rayotube immediately and adjust the compensator until the temperature reading of the recorder agrees with the temperature reading of the optical pyrometer or thermocouple measurement.

Rayotube recorders which do not have a compensator are calibrated in a simpler fashion. Measure the temperature of the hot body with an optical pyrometer and then with the Rayotube and its recorder. If the recorder scale reading does not agree with that of the pyrometer, turn the adjustment screw on the power supply unit until the two do correspond.

The "flip up-scale" device used on some Rayotube recorders is no longer needed once the power supply unit is installed.

4. THEORY OF OPERATION

The function of the power supply unit is to transform normal, a-c line power to d-c power having a very stable 10 ma output current (reduced to 5 ma by an external shunting resistor for Speedomax H applications). Hence the unit must perform essentially two operations: rectification and voltage-current regulation.

Fig. 16 illustrates the elementary wiring of the power supply unit; miniature electronic components and printed circuitry are employed throughout. Stepdown power transformer T1 reduces the 120 V (nominal) a-c input. Rectification is accomplished by a silicon diode bridge circuit (Y1-Y4) and its output ripple voltage is diminished by capacitor C1

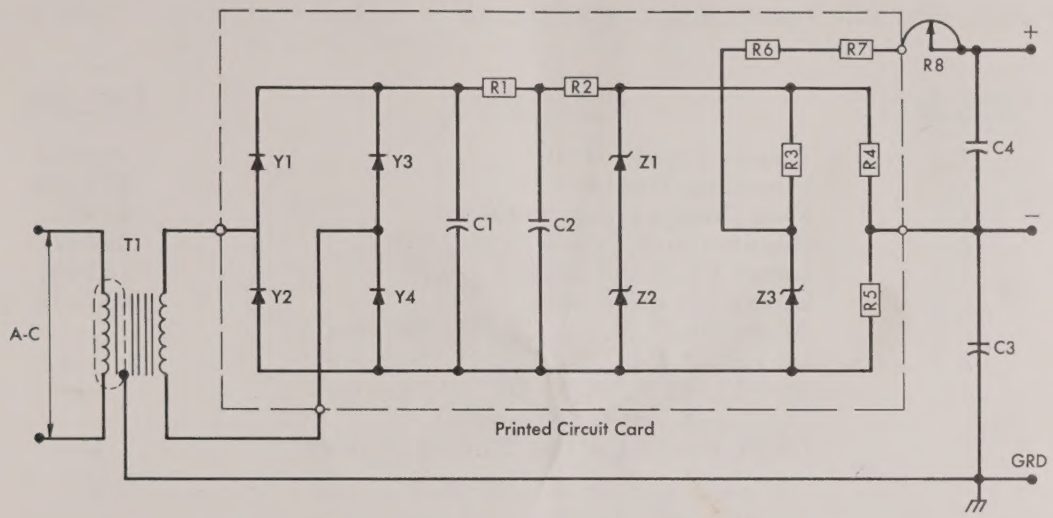

Fig. 16—Internal wiring schematic of power supply unit.

and the single section filter R1-C2. The first stage of current regulation consists of a pair of Zener diodes connected in series (Z1-Z2). The second stage of regulation consists of precision resistors R3, R4, R5, and Zener diode Z3, which are connected together as a bridge circuit. Zener diodes are temperature sensitive devices, thus making it necessary to provide some means of compensating for ambient temperature changes. This is accomplished by winding a nickel coil around diode Z3 and encapsulating the coil-diode combination so that they will always be at the same temperature level. Since the encapsulated nickel coil (R6) is wired in series with the output of the bridge, any temperature changes at the diode (which affect the nickel coil an equal amount) will be automatically compensated for. Resistor R7 and rheostat R8 (to which the external adjustment screw is attached), are needed to maintain an output voltage between 1.01 and 1.09 V for the fixed 10 ma load current. The output terminals of the power supply are by-passed, with a capacitance, to ground to minimize a-c leakage currents in the output.

5. MAINTENANCE

As has been stated, any future changes in the electrical circuitry of the recorder, such as the installation of new parts or repair work, will necessitate re-executing the adjustment and calibration procedure described in Section 3. As a part of this procedure it may be necessary to check the power supply unit with a voltmeter at its output terminals (marked + and –), but there are no checks to be made on the internal circuitry of the unit itself.

6. PARTS SUPPLIED WITH POWER SUPPLY UNIT CONVERSION KITS

See following pages for lists of parts.

KIT #124198—For Speedomax G Recorders

Quantity	Description	Part No.
1	Power Supply Unit	099012
1	Mounting Bracket	073715
1	Flat Composition Insulator	034571
2	Countersunk Screw Insulator	034572
1	Label (X-X recorders only)	187151
1	Leads (in envelope)	037435
2	3/8 #8-32 F.H.B. Cr. P. Screws	---
2	1/2 #8-32 F.H.B. Cr. P. Screws	---
2	3/8 #10-32 F.H.B. Cr. P. Screws (X-X recorders only)	---
2	1/4 #6 Binding Head Slotted Screws	---

KIT #124195—For Speedomax H Recorders With Standard 5-Second Balance Time

Quantity	Description	Part No.
1	Power Supply Unit	099012
1	Mounting Bracket	073715
1	Flat Composition Insulator	034571
2	Countersunk Screw Insulator	034572
1	Resistor (208 ohm, ±0.5%, 1 W)	011646
1	Motor Circuit Cable	037637
1	Measuring Circuit Cable	037638
1	Cable Clamp	072431
2	5/16 #8-32 F.H.B. Cr. P. Screws	---
4	1/4 #6 Binding Head Slotted Screws	---

KIT #124196—For Speedomax H Recorders With 1-Second Balance Time

Quantity	Description	Part No.
1	Power Supply Unit	099012
1	Mounting Bracket	073715
1	Flat Composition Insulator	034571
2	Countersunk Screw Insulator	034572
1	Resistor (208 ohm, ±0.5%, 1 W)	011646
1	Motor Circuit Cable	037637
1	Measuring Circuit Cable	037639
1	Cable Clamp	072431
2	5/16 #8-32 F.H.B. Cr. P. Screws	---
4	1/4 #6 Binding Head Slotted Screws	---

KIT #124197—For Speedomax H Recorders With 5-Second Balance Time and an Amplifier Fail-Safe (Upscale) Attachment

Quantity	Description	Part No.
1	Power Supply Unit	099012
1	Mounting Bracket	073715
1	Flat Composition Insulator	034571
2	Countersunk Screw Insulator	034572
1	Resistor (208 ohm, ±0.5%, 1 W)	011646
1	Motor Circuit Cable	037637
1	Measuring Circuit Cable	037638
1	Adapter Plug (Amplifier to motor circuit cable)	040221
1	Adapter (Converter to converter cable)	128079
1	Cable Clamp	072431
2	5/16 #8-32 F.H.B. Cr. P. Screws	---
4	1/4 #6 Binding Head Slotted Screws	---

KIT #124221—For Speedomax H Recorders With 1-Second Balance Time and an Amplifier Fail-Safe (Upscale) Attachment

Quantity	Description	Part No.
1	Power Supply Unit	099012
1	Mounting Bracket	073715
1	Flat Composition Insulator	034571
2	Countersunk Screw Insulator	034572
1	Resistor (208 ohm, ±0.5%, 1 W)	011646
1	Motor Circuit Cable	037637
1	Measuring Circuit Cable	037639
1	Adapter Plug (Amplifier to motor circuit cable)	040221
1	Adapter (Converter to converter cable)	128079
2	5/16 #8-32 F.H.B. Cr. P. Screws	---
4	1/4 #6 Binding Head Slotted Screws	---

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